CLAIMS

What is claimed is:

1. A method for identifying systematic errors in a data recording device, comprising:

writing a plurality of data set to a recording medium, each data set comprising a plurality of data segments;

identifying erroneously written data segments of each data set;

for each data set, storing in a buffer cell a value representative of the number of erroneously written data segments for the data set;

determining the number PR_{1A} of a first plurality L of buffer cells which contain stored values in excess of a first predetermined threshold value TH_{HB-1A};

determining the number PR_{2A} of a second plurality M of buffer cells which contain stored values in excess of a second predetermined threshold value TH_{HB-2A}, where M<L; and

generating an output signal indicating at least one of: whether the number PR_{1A} exceeds a third predetermined threshold value TH_{PR-1A} and whether the number PR_{2A} exceeds a fourth predetermined threshold value TH_{PR-2A}.

2. The method of claim 1, further comprising:

reading back each data set;

re-writing the erroneously written data segments of the data set to the recording medium;

repeating the writing, reading, re-writing and storing steps until the plurality of L data sets have been written to the recording medium and a like plurality of values have been stored in successive buffer cells, including the plurality of M successively stored values;

wherein the value representative of the number of erroneously written data segments is representative of the number of re-written data segments for the data set;

wherein the output signal further indicates

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a first state if PR_{1A} is less than the third threshold value TH_{PR-1A} and PR_{2A} is less than the fourth predetermined threshold value TH_{PR-2A}, the first state indicative of a non-error condition;

a second state if PR_{1A} is less than the third threshold value TH_{PR-1A} and PR_{2A} is greater than the fourth predetermined threshold value TH_{PR-2A}, the second state indicative of a late-occurring event;

a third state if PR_{1A} is greater than the third threshold value TH_{PR-1A} and PR_{2A} is less than the fourth predetermined threshold value TH_{PR-2A}, the third state indicative of a transient event; and

a fourth state if PR_{1A} is greater than the third threshold value TH_{PR-1A} and PR_{2A} is greater than the fourth predetermined threshold value TH_{PR-2A}, the fourth state indicative of a systematic condition.

3. The method of claim 1, further comprising:

setting a variable P_A equal to 1 if PR_{1A} exceeds TH_{PR-1A} and otherwise setting P_A equal to 0; and

setting a variable Q_A equal to 1 if PR_{2A} exceeds TH_{PR-2A} and otherwise setting Q_A equal to 0;

whereby:

the output signal is in the first state if both P_A and Q_A equal 0;

the output signal is in the second state if P_A equals 0 and Q_A equals 1;

the output signal is in the third state if P_A equals 1 and Q_A equals 0; and

the output signal is in the fourth state if both P_A and Q_A equal 1.

4. The method of claim 3, further comprising:

determining the number PR_{1B} of the L buffer cells which contain stored values in excess of a third predetermined threshold value TH_{HB-1B};

determining the number PR_{2B} of the M buffer cells which contain stored values in excess of a fourth predetermined threshold value TH_{HB-2B};

generating the output signal having fifth through twentieth states, each state indicative of a characteristic of the data recording device, the fifth, ninth, thirteenth and seventeenth states corresponding to the first, second, third and fourth states, respectively.

5. The method of claim 4, further comprising:

setting a variable P_B equal to 1 if PR_{1B} exceeds TH_{PR-1B} and otherwise setting P_B equal to 0; and

setting a variable Q_B equal to 1 if PR_{2B} exceeds TH_{PR-2B} and otherwise setting Q_B equal to 0.

6. The method of claim 5, wherein the output signal is in the fifth through twentieth states according to a state table:

State Table

P_A	Q_A	P_B	Q_B	State
0	0	0	0	5
0	0	0	1	6
0	0	1	0	7
0	0	1	1	8
0	1	0	0	9
0	1	0	1	10
0	1	1	0	11
0	1	1	1	12
1	0	0	0	13
1	0	0	1	14
1	0	1	0	15
1	0	1	1	16
1	1	0	0	17
1	1	0	1	18
1	1	1	0	19
1	1	1	1	20

7. The method of claim 5, further comprising:

setting $TH_{HB-1A} < TH_{HB-1B}$ and setting $TH_{PR-1A} \leq TH_{PR-1B}$, whereby, when $P_B = 1$, $P_A=1$;

setting $TH_{HB\text{-}2A} < TH_{HB\text{-}2B}$ and setting $TH_{PR\text{-}2A} \leq TH_{PR\text{-}2B}$, whereby, when $Q_B = 1$, $Q_A = 1$; and

generating the output signal according to a reduced state table:

Reduced State Table

P_A	Q_A	P_B	Q_B	State
0	0	0	0	5
0	1	0	0	9
0	1	0	1	10
1	0	0	0	13
1	0	1	0	15
1	1	0	0	17
1	1	0	1	18
1	1	1	0	19
1	1	1	1	20

8. The method of claim 1, wherein the M stored values are the M most recently stored successive values.

9. The method of claim 1, wherein the value stored in each buffer cell equals the number of erroneously written data segments for the data set.

10. The method of claim 1, wherein the value stored in each buffer cell equals the total number of data segments written for the data set.

11. The method of claim 1, wherein a new output signal is generated every time a value is stored in a buffer cell.

12. The method of claim 1, wherein the output signal is generated at the end of a recording operation.

13. The method of claim 1, further comprising:

determining the number PR_{1B} of the L buffer cells which contain stored values in excess of a fifth predetermined threshold value $TH_{PR\text{-}1B}$;

determining the number PR_{2B} of the M buffer cells which contain stored values in excess of a sixth predetermined threshold value TH_{PR-2B}; and

generating an output signal indicating at least one of: whether the number PR_{1A} exceeds a seventh predetermined threshold value TH_{PR-1A} and whether the number PR_{2A} exceeds an eighth predetermined threshold value TH_{PR-2A}.

14. Controller logic for a data recording device, the data recording device for recording data sets to a recording medium, each data set comprising a plurality of data segments, wherein during a data recording operation, erroneous data segments of a data set recorded on the recording medium are identified, the controller logic comprising:

a buffer comprising a set of L cells, including a sub-set of M cells, where $M<L$, each storage cell for containing a value representing the number of erroneous data segments of a data set;

a first network, comprising means for determining a number PR_{1A} representing the number of the L cells having a value which exceeds a first predetermined threshold TH_{HB-1A};

a second network, comprising

means for determining a number PR_{2A} representing the number of the M cells having a value which exceeds a second predetermined threshold TH_{HB-2A}; and

a combinatorial logic unit coupled to outputs of the first and second networks and having an output signal indicating at least one of: whether the number PR_{1A} exceeds a third predetermined threshold value TH_{PR-1A} and whether the number PR_{2A} exceeds a fourth predetermined threshold value TH_{PR-2A}.

15. The controller logic of claim 14, wherein:

the first network further comprises means for generating an output P_A having a state of 1 if PR_{1A} exceeds the third predetermined threshold TH_{PR-1A} and otherwise having a state of 0;

the second network further comprises means for generating an output Q_A having a state of 1 if PR_{2A} exceeds the fourth predetermined threshold TH_{PR-2A} and otherwise having a state of 0; and

the combinatorial logic unit further comprises:

first and second inputs coupled to receive the outputs P_A and Q_A from the first and second networks; and

an output having:

a first state if P_A and Q_A equal 0, the first state indicative of a non-error condition;

a second state if P_A equals 0 and Q_A equals 1, the second state indicative of a late-occurring event;

a third state if P_A equals 1 and Q_A equals 0, the third state indicative of a transient event; and

a fourth state if P_A and Q_A equal 1, the fourth state indicative of a systematic condition.

16. The controller logic of claim 15, wherein:

in the first network:

the means for determining the number PR_{1A} comprises:

a first comparator for comparing each value in the L buffer cells with the first predetermined threshold TH_{HB-1A}; and

a first counter for counting the number of values in the L buffer cells having a value in excess of TH_{HB-1A}, the first counter having an output for outputting the number PR_{1A}; and

the means for generating an output P_A comprises a second comparator for comparing the output of the first counter PR_{1A} to the third predetermined threshold TH_{PR-1A}; and

in the second network:

the means for determining the number PR_{2A} comprises:

a third comparator for comparing each value in the M buffer cells with the second predetermined threshold TH_{HB-2A}; and

a second counter for counting the number of values in the M buffer cells having a value in excess of TH_{HB-2A}, the second counter having an output for outputting the number PR_{2A}; and

the means for generating an output Q_A comprises a fourth comparator for comparing the output of the second counter PR_{2A} to the fourth predetermined threshold TH_{PR-2A}.

17. The controller logic of claim 15, further comprising:

a third network, comprising:

means for determining a number PR_{1B} representing the number of the L cells having a value which exceeds a fifth predetermined threshold TH_{HB-1B}; and

means for generating an output P_B having a state of 1 if PR_{1B} exceeds a sixth predetermined threshold TH_{PR-1B} and otherwise having a state of 0;

a fourth network, comprising:

means for determining a number PR_{2B} representing the number of the M cells having a value which exceeds a seventh predetermined threshold TH_{HB-2B}; and

means for generating an output Q_B having a state of 1 if PR_{2B} exceeds an eighth predetermined threshold TH_{PR-2B}, otherwise having a state of 0; and

the combinatorial logic unit further comprises third and fourth inputs for receiving the outputs P_B and Q_B from the third and fourth networks, the output further having fifth through twentieth states, each state indicative of a characteristic of the data recording device, wherein the fifth, ninth, thirteenth and seventeenth states correspond to the first, second, third and fourth states, respectively.

18. The controller logic of claim 17, wherein the output of the combinatorial logic unit is in the fifth through twentieth states according to a state table:

State Table

P_A	Q_A	P_B	Q_B	State
0	0	0	0	5
0	0	0	1	6
0	0	1	0	7
0	0	1	1	8
0	1	0	0	9
0	1	0	1	10
0	1	1	0	11
0	1	1	1	12
1	0	0	0	13
1	0	0	1	14
1	0	1	0	15
1	0	1	1	16
1	1	0	0	17
1	1	0	1	18
1	1	1	0	19
1	1	1	1	20

19. The controller logic of claim 17, wherein:

$TH_{HB\text{-}1A} < TH_{HB\text{-}1B}$ and $TH_{PR\text{-}1A} \leq TH_{PR\text{-}1B}$, whereby, when $P_B = 1$, $P_A=1$;

$TH_{HB\text{-}2A} < TH_{HB\text{-}2B}$ and $TH_{PR\text{-}2A} \leq TH_{PR\text{-}2B}$, whereby, when $Q_B = 1$, $Q_A=1$; and

the combinatorial logic unit generates the output signal according to a reduced state table:

Reduced State Table

P_A	Q_A	P_B	Q_B	State
0	0	0	0	5
0	1	0	0	9
0	1	0	1	10
1	0	0	0	13
1	0	1	0	15
1	1	0	0	17
1	1	0	1	18
1	1	1	0	19
1	1	1	1	20

20. The controller logic of claim 14, wherein the second network further comprises means for reading the M values.

21. The controller logic of claim 14, wherein the second network further comprises means for reading the M most recently stored successive values.

22. The controller logic of claim 14, wherein the value stored in each buffer cell equals the number of erroneously written data segments for the data set.

23. The controller logic of claim 14, wherein the value stored in each buffer cell equals the total number of data segments written for the data set.

24. The controller logic of claim 14, wherein a new output signal is generated every time a value is stored in a buffer cell.

25. The controller logic of claim 14, wherein the data recording device is a multi-wrap tape device and the output signal is generated when the data storage write operation reaches the end of a tape wrap.

26. The controller logic of claim 14, wherein the data recording device is an optical disc recording device.

27. The controller logic of claim 14, wherein the output signal is generated at the end of a recording operation.

28. The controller logic of claim 14, further comprising:

a third network comprising means for determining a number PR_{1B} of the L buffer cells which contain stored values in excess of a fifth predetermined threshold value TH_{PR-1B}; and

a fourth network comprising means for determining a number PR_{2B} of the M buffer cells which contain stored values in excess of a sixth predetermined threshold value TH_{PR-2B};

wherein the combinatorial logic unit is further coupled to outputs of the third and fourth networks and the output signal indicates at least one of: whether the number PR_{1A} exceeds a seventh predetermined threshold value TH_{PR-1A} and whether the number PR_{2A} exceeds an eighth predetermined threshold value TH_{PR-2A}.

29. A data recording device, comprising:

a transducer head for recording data to and reading data from a recordable medium;

a transport mechanism the recordable medium past the transducer head;

a data write channel for transmitting signals to the transducer head whereby data, comprising data sets, are recorded on the recordable medium during a recording operation, each data set comprising a plurality of data segments;

a data read channel for receiving signals from the transducer head whereby recorded data sets are read from the recordable medium; and

a write error detection unit coupled to the data write channel and the data read channel for detecting errors in recorded data segments;

a control unit coupled to the data write channel;

a buffer comprising a set of L cells, including a sub-set of M cells, where M<L, each storage cell for containing a value representing the number of erroneously written data segments of a data set which were written during a recording operation;

a first network, comprising means for determining a number PR_{1A} representing the number of the L cells having a value which exceeds a first predetermined threshold TH_{HB-1A};

a second network, comprising means for determining a number PR_{2A} representing the number of the M cells having a value which exceeds a third predetermined threshold TH_{HB-2A}; and

a combinatorial logic unit coupled to outputs of the first and second networks and having an output signal indicating at least one of: whether the number PR_{1A} exceeds a third predetermined threshold value TH_{PR-1A} and whether the number PR_{2A} exceeds a fourth predetermined threshold value TH_{PR-2A}.

30. The data recording device of claim 29, wherein:

the first network further comprises means for generating an output P_A having a state of 1 if PR_{1A} exceeds the third predetermined threshold TH_{PR-1A} and otherwise having a state of 0;

the second network further comprises means for generating an output Q_A having a state of 1 if PR_{2A} exceeds the fourth predetermined threshold TH_{PR-2A} and otherwise having a state of 0; and

the combinatorial logic unit further comprises:

first and second inputs coupled to receive the outputs P_A and Q_A from the first and second networks; and

an output having:

a first state if P_A and Q_A equal 0, the first state indicative of a non-error condition;

a second state if P_A equals 0 and Q_A equals 1, the second state indicative of a late-occurring event;

a third state if P_A equals 1 and Q_A equals 0, the third state indicative of a transient event; and

a fourth state if P_A and Q_A equal 1, the fourth state indicative of a systematic condition.

31. The data recording device of claim 30, wherein:

in the first network:

the means for determining the number PR_{1A} comprises:

a first comparator for comparing each value in the L buffer cells with the first predetermined threshold TH_{HB-1A}; and

a first counter for counting the number of values in the L buffer cells having a value in excess of TH_{HB-1A}, the first counter having an output for outputting the number PR_{1A}; and

the means for generating an output P_A comprises a second comparator for comparing the output of the first counter PR_{1A} to the second predetermined threshold TH_{PR-1A}; and

in the second network:

the means for determining the number PR_{2A} comprises:

a third comparator for comparing each value in the M buffer cells with the third predetermined threshold TH_{HB-2A}; and

a second counter for counting the number of values in the M buffer cells having a value in excess of TH_{HB-2A}, the second counter having an output for outputting the number PR_{2A}; and

the means for generating an output Q_A comprises a fourth comparator for comparing the output of the second counter PR_{2A} to the fourth predetermined threshold TH_{PR-2A}.

32. The data recording device of claim 30, further comprising:

a third network, comprising:

means for determining a number PR_{1B} representing the number of the L cells having a value which exceeds a fifth predetermined threshold TH_{HB-1B}; and

means for generating an output P_B having a state of 1 if PR_{1B} exceeds a sixth predetermined threshold TH_{PR-1B} and otherwise having a state of 0;

a fourth network, comprising:

means for determining a number PR_{2B} representing the number of the M cells having a value which exceeds a seventh predetermined threshold TH_{HB-2B}; and

means for generating an output Q_B having a state of 1 if PR_{2B} exceeds an eighth predetermined threshold TH_{PR-2B}, otherwise having a state of 0; and

the combinatorial logic unit further comprises third and fourth inputs for receiving the outputs P_B and Q_B from the third and fourth networks, the output further having fifth through twentieth states, each state indicative of a characteristic of the data recording device, wherein the fifth, ninth, thirteenth and seventeenth states correspond to the first, second, third and fourth states, respectively.

33. The data recording device of claim 32, wherein the output of the combinatorial logic unit is in the fifth through twentieth states according to a state table:

State Table

P_A	Q_A	P_B	Q_B	State
0	0	0	0	5
0	0	0	1	6
0	0	1	0	7
0	0	1	1	8
0	1	0	0	9
0	1	0	1	10
0	1	1	0	11
0	1	1	1	12
1	0	0	0	13
1	0	0	1	14
1	0	1	0	15
1	0	1	1	16
1	1	0	0	17
1	1	0	1	18
1	1	1	0	19
1	1	1	1	20

34. The data recording device of claim 32, wherein:

$TH_{HB-1A} < TH_{HB-1B}$ and $TH_{PR-1A} \leq TH_{PR-1B}$, whereby, when $P_B = 1$, $P_A=1$;

$TH_{HB-2A} < TH_{HB-2B}$ and $TH_{PR-2A} \leq TH_{PR-2B}$, whereby, when $Q_B = 1$, $Q_A=1$; and

the combinatorial logic unit generates the output signal according to a reduced state table:

Reduced State Table

P_A	Q_A	P_B	Q_B	State
0	0	0	0	5
0	1	0	0	9
0	1	0	1	10
1	0	0	0	13
1	0	1	0	15
1	1	0	0	17
1	1	0	1	18
1	1	1	0	19
1	1	1	1	20

35. The data recording device of claim 29, wherein the second network comprises means for reading the M values.

36. The data recording device of claim 29, wherein the second network comprises means for reading the M most recently stored successive values.

37. The data recording device of claim 29, wherein the value stored in each buffer cell equals the number of erroneously written data segments for the data set.

38. The data recording device of claim 29, wherein the value stored in each buffer cell equals the total number of data segments written for the data set.

39. The data recording device of claim 29, wherein a new output signal is generated every time a value is stored in a buffer cell.

40. The data recording device of claim 29, wherein the output signal is generated at the end of the data storage write operation.

41. The data recording device of claim 29, wherein the data recording device is a magnetic recording drive and the recording medium is a magnetic tape medium.

42. The data recording device of claim 41, wherein the recordable medium is a multi-wrap recordable medium and the output signal is generated when the data recording operation reaches the end of a wrap.

43. The data recording device of claim 29, wherein the data recording device in an optical recording device and the recording medium is a recordable optical disc.

44. The data recording device of claim 29, further comprising:

a third network comprising means for determining a number PR_{1B} of the L buffer cells which contain stored values in excess of a fifth predetermined threshold value TH_{PR-1B}; and

a fourth network comprising means for determining a number PR_{2B} of the M buffer cells which contain stored values in excess of a sixth predetermined threshold value TH_{PR-2B};

wherein the combinatorial logic unit is further coupled to outputs of the third and fourth networks and the output signal indicates at least one of: whether the number PR_{1A} exceeds a seventh predetermined threshold value TH_{PR-1A} and whether the number PR_{2A} exceeds an eighth predetermined threshold value TH_{PR-2A}.

45. A computer program product of a computer readable medium usable with a programmable computer, the computer program product having computer-readable code embodied therein for identifying systematic errors during a write operation in a data recording device, the computer-readable code comprising instructions for:

writing a plurality of data set to a recording medium, each data set comprising a plurality of data segments;

identifying erroneously written data segments of each data set;

for each data set, storing in a buffer cell a value representative of the number of erroneously written data segments for the data set;

determining the number PR_{1A} of a first plurality of L buffer cells which contain stored values in excess of a first predetermined threshold value TH_{HB-1A};

determining the number PR_{2A} of a second plurality of M buffer cells which contain stored values in excess of a second predetermined threshold value TH_{HB-2A}, where $M<L$; and

generating an output signal indicating at least one of: whether the number PR_{1A} exceeds a third predetermined threshold value TH_{PR-1A} and whether the number PR_{2A} exceeds a fourth predetermined threshold value TH_{PR-2A}.

46. The computer program of claim 45, wherein the computer-readable code further comprises instructions for:

reading back each data set;

re-writing the erroneously written data segments of the data set to the recording medium;

repeating the writing, reading, re-writing and storing steps until the plurality of L data sets have been written to the recording medium and a like plurality of values have been stored in successive buffer cells, including the plurality of M successively stored values;

wherein the output signal further indicates

a first state if PR_{1A} is less than a third threshold value TH_{PR-1A} and PR_{2A} is less than a fourth predetermined threshold value TH_{PR-2A}, the first state indicative of a non-error condition;

a second state if PR_{1A} is less than the third threshold value TH_{PR-1A} and PR_{2A} is greater than the fourth predetermined threshold value TH_{PR-2A}, the second state indicative of a late-occurring event;

a third state if PR_{1A} is greater than the third threshold value TH_{PR-1A} and PR_{2A} is less than the fourth predetermined threshold value TH_{PR-2A}, the third state indicative of a transient event; and

a fourth state if PR_{1A} is greater than the third threshold value TH_{PR-1A} and PR_{2A} is greater than the fourth predetermined threshold value TH_{PR-2A}, the fourth state indicative of a systematic condition.

47. The computer program product of claim 45, wherein the computer-readable code further comprises instructions for:

setting a variable P_A equal to 1 if PR_{1A} exceeds TH_{PR-1A} and otherwise setting P_A equal to 0; and

setting a variable Q_A equal to 1 if PR_{2A} exceeds TH_{PR-2A} and otherwise setting Q_A equal to 0;

whereby:

the output signal is in the first state if both P_A and Q_A equal 0;

the output signal is in the second state if P_A equals 0 and Q_A equals 1;

the output signal is in the third state if P_A equals 1 and Q_A equals 0; and

the output signal is in the fourth state if both P_A and Q_A equal 1.

48. The computer program product of claim 47, wherein the computer-readable code further comprises instructions for:

determining the number PR_{1B} of the L buffer cells which contain stored values in excess of a fifth predetermined threshold value TH_{HB-1B};

determining the number PR_{2B} of the M buffer cells which contain stored values in excess of a sixth predetermined threshold value TH_{HB-2B};

generating the output signal having fifth through twentieth states, each state indicative of a characteristic of the data recording device, the fifth, ninth, thirteenth and seventeenth states corresponding to the first, second, third and fourth states, respectively.

49. The computer program product of claim 48, wherein the computer-readable code further comprises instructions for:

setting a variable P_B equal to 1 if PR_{1B} exceeds TH_{PR-1B} and otherwise setting P_B equal to 0; and

setting a variable Q_B equal to 1 if PR_{2B} exceeds TH_{PR-2B} and otherwise setting Q_B equal to 0.

50. The computer program product of claim 49, wherein the output signal is in the fifth through twentieth states according to a state table:

State Table

P_A	Q_A	P_B	Q_B	State
0	0	0	0	5
0	0	0	1	6
0	0	1	0	7
0	0	1	1	8
0	1	0	0	9
0	1	0	1	10
0	1	1	0	11
0	1	1	1	12
1	0	0	0	13
1	0	0	1	14
1	0	1	0	15
1	0	1	1	16
1	1	0	0	17
1	1	0	1	18
1	1	1	0	19
1	1	1	1	20

51. The computer program product of claim 49, wherein the computer-readable code further comprises instructions for:

setting $TH_{HB-1A} < TH_{HB-1B}$ and setting $TH_{PR-1A} \leq TH_{PR-1B}$, whereby, when $P_B = 1$, $P_A=1$;

setting $TH_{HB-2A} < TH_{HB-2B}$ and setting $TH_{PR-2A} \leq TH_{PR-2B}$, whereby, when $Q_B = 1$, $Q_A=1$; and

generating the output signal according to a reduced state table:

Reduced State Table

P_A	Q_A	P_B	Q_B	State
0	0	0	0	5
0	1	0	0	9
0	1	0	1	10
1	0	0	0	13
1	0	1	0	15
1	1	0	0	17
1	1	0	1	18
1	1	1	0	19
1	1	1	1	20

52. The computer program product of claim 45, wherein the value stored in each buffer cell equals the number of erroneously written data segments for the data set.

53. The computer program product of claim 45, wherein the value stored in each buffer cell equals the total number of data segments written for the data set.

54. The computer program product of claim 45, wherein a new output signal is generated every time a value is stored in a buffer cell.

55. The computer program product of claim 45, wherein the M stored values are the M most recently stored successive values.

56. The computer program product of claim 45, wherein the output signal is generated at the end of a write operation.

57. The computer program of claim 45, wherein the computer-readable code further comprises instructions for:

determining the number PR_{1B} of the L buffer cells which contain stored values in excess of a fifth predetermined threshold value $TH_{PR\text{-}1B}$;

determining the number PR_{2B} of the M buffer cells which contain stored values in excess of a sixth predetermined threshold value $TH_{PR\text{-}2B}$; and

generating an output signal indicating at least one of: whether the number PR_{1A} exceeds a seventh predetermined threshold value $TH_{PR\text{-}1A}$ and whether the number PR_{2A} exceeds an eighth predetermined threshold value $TH_{PR\text{-}2A}$.